# CANopen application layer and general communication profile

## Object dictionary (OD)

### Overview

| Index range | Description |
|---|---|
| $0000_h$ | Reserved |
| $0001_h$ to $025F_h$ | Data types |
| $0260_h$ to $0FFF_h$ | Reserved |
| $1000_h$ to $1FFF_h$ | Communication profile area |
| $2000_h$ to $5FFF_h$ | Manufacturer-specific profile area |
| $6000_h$ to $9FFF_h$ | Standardized profile area |
| $A000_h$ to $AFFF_h$ | Network variables |
| $B000_h$ to $BFFF_h$ | System variables |
| $C000_h$ to $FFFF_h$ | Reserved |

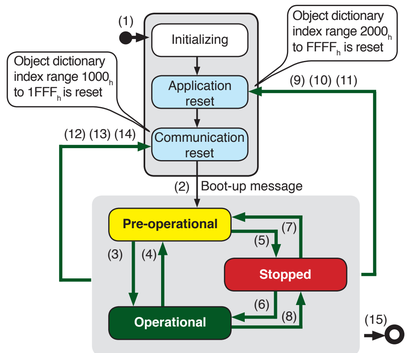
### Communication profile area

| Index range | Description |
|---|---|
| $1000_h$ to $1029_h$ | General communication objects |
| $1200_h$ to $12FF_h$ | SDO parameter objects |
| $1300_h$ to $13FF_h$ | CANopen safety objects |
| $1400_h$ to $1BFF_h$ | PDO parameter objects |
| $1F00_h$ to $1F11_h$ | SDO manager objects |
| $1F20_h$ to $1F27_h$ | Configuration manager objects |
| $1F50_h$ to $1F54_h$ | Program control objects |
| $1F80_h$ to $1F89_h$ | NMT master objects |

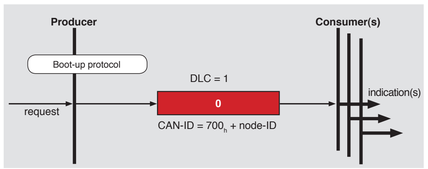
### General communication objects

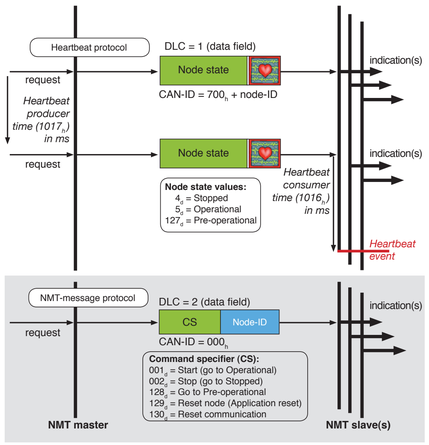
| Index | Object | Name |
|---|---|---|
| $1000_h$ | VAR | Device type |
| $1001_h$ | VAR | Error register |
| $1002_h$ | VAR | Manufacturer status register |
| $1003_h$ | ARRAY | Pre-defined error field |
| $1005_h$ | VAR | COB-ID Sync message |
| $1006_h$ | VAR | Communication cycle period |
| $1007_h$ | VAR | Synchronous window length |
| $1008_h$ | VAR | Manufacturer device name |
| $1009_h$ | VAR | Manufacturer hardware version |
| $100A_h$ | VAR | Manufacturer software version |
| $100C_h$ | VAR | Guard time |
| $100D_h$ | VAR | Life time factor |
| $1010_h$ | ARRAY | Store parameters |
| $1011_h$ | ARRAY | Restore default parameters |
| $1012_h$ | VAR | COB-ID time stamp |
| $1013_h$ | VAR | High resolution time stamp |
| $1014_h$ | VAR | COB-ID emergency |
| $1015_h$ | VAR | Inhibit time emergency |
| $1016_h$ | ARRAY | Consumer heartbeat time |
| $1017_h$ | VAR | Producer heartbeat time |
| $1018_h$ | RECORD | Identity object |
| $1019_h$ | VAR | Sync. counter overflow value |
| $1020_h$ | ARRAY | Verify configuration |
| $1021_h$ | VAR | Store EDS |
| $1022_h$ | VAR | Storage format |
| $1023_h$ | RECORD | OS command |
| $1024_h$ | VAR | OS command mode |
| $1025_h$ | RECORD | OS debugger interface |
| $1026_h$ | ARRAY | OS prompt |
| $1027_h$ | ARRAY | Module list |
| $1028_h$ | ARRAY | Emergency consumer |
| $1029_h$ | ARRAY | Error behavior |

## Network management (NMT)

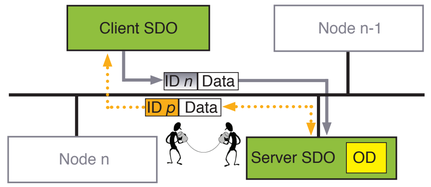



(1) Power on
(2) Automatic switch to Pre-operational
(3) and (6) NMT switch to Operational
(4) and (7) NMT switch to Pre-operational
(5) and (8) NMT switch to Stopped
(9), (10) and (11) NMT switch to Application reset
(12), (13) and (14) NMT switch to Communication reset
(15) Power-off or hardware reset

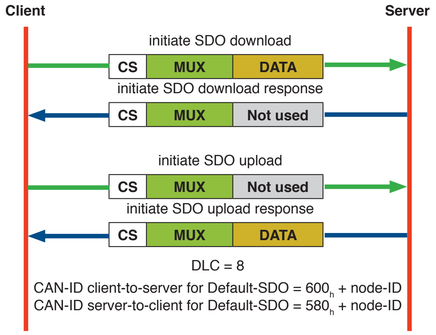



## Service data object (SDO)




### Expedited SDO protocol

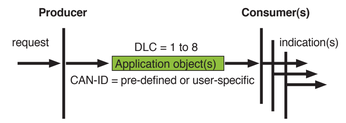



CS: Command specifier (read or write access, transfer type)
MUX: Multiplexer (index and sub-index of an object)

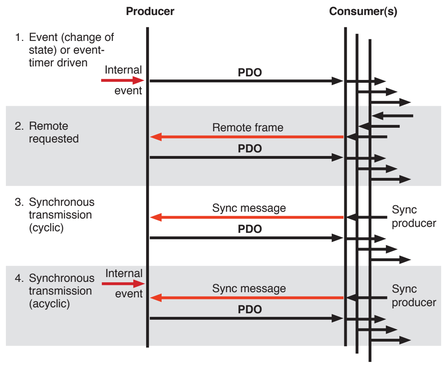
### Normal SDO protocol




## Process data object (PDO)



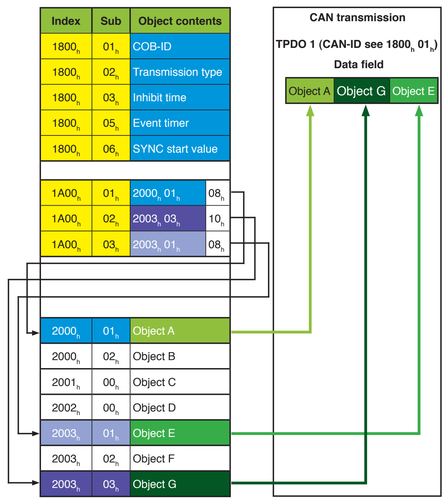

### PDO protocol




### PDO communication parameter

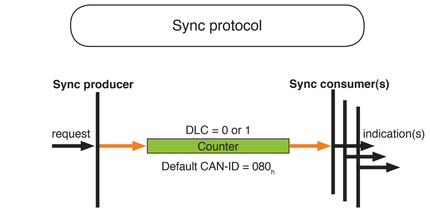
| Index | Sub-index | Description | Data type |
|---|---|---|---|
| **RPDO:** $1400_h$ to $15FF_h$ | $00_h$ | Number of entries | Unsigned8 |
| | $01_h$ | COB-ID | Unsigned32 |
| | $02_h$ | Transmission type | Unsigned8 |
| | $03_h$ | Inhibit time | Unsigned16 |
| | $04_h$ | Reserved | Unsigned8 |
| **TPDO:** $1800_h$ to $19FF_h$ | $05_h$ | Event timer | Unsigned16 |
| | $06_h$ | SYNC start value | Unsigned8 |

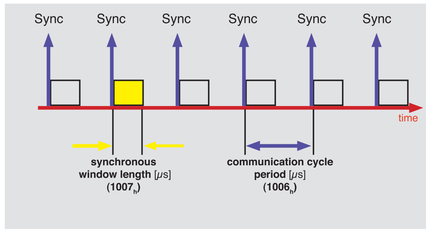
### PDO mapping



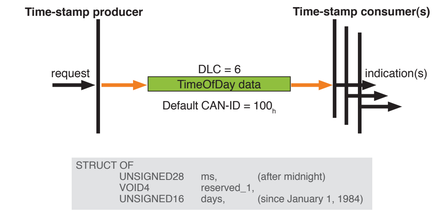

## Special protocols

### Sync protocol



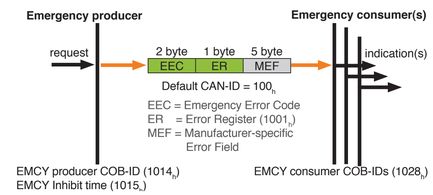

### Time-stamp protocol




| STRUCT OF | | |
|---|---|---|
| UNSIGNED28 | ms, | (after midnight) |
| VOID4 | reserved_1, | |
| UNSIGNED16 | days, | (since January 1, 1984) |

TIME COB-ID ($1012_h$)

### Emergency protocol




EMCY producer COB-ID ($1014_h$)
EMCY Inhibit time ($1015_h$)
EMCY consumer COB-IDs ($1028_h$)

### Emergency error codes

| | | | |
|---|---|---|---|
| $00xx_h$ | **Error reset or no error** | $60xx_h$ | **Device software** |
| $10xx_h$ | **Generic error** | $61xx_h$ | internal |
| $20xx_h$ | **Current** | $62xx_h$ | user |
| $21xx_h$ | device input side | $63xx_h$ | data set |
| $22xx_h$ | inside of device | $70xx_h$ | **Additional modules** |
| $23xx_h$ | device output side | $80xx_h$ | **Monitoring** |
| $30xx_h$ | **Voltage** | $81xx_h$ | communication |
| $31xx_h$ | main | $8110_h$ | CAN overrun |
| $32xx_h$ | inside of device | $8120_h$ | Error Passive (EP) |
| $33xx_h$ | output | $8130_h$ | Life Guard Error |
| $40xx_h$ | **Temperature** | $8140_h$ | recovered from Bus-off |
| $41xx_h$ | ambient | $82xx_h$ | **Protocol error** |
| $42xx_h$ | device | $8210_h$ | PDO not processed |
| $50xx_h$ | **Device hardware** | $8220_h$ | length exceeded |
| | | $90xx_h$ | **External error** |
| | | $F0xx_h$ | **Additional functions** |
| | | $FFxx_h$ | **Device-specific** |

## Pre-defined CAN-IDs

| Object | Specification | CAN-ID |
|---|---|---|
| NMT | CiA 301 | $000_h$ |
| Global failsafe command | CiA 304 | $001_h$ |
| Flying master | CiA 302-2 | $071_h$ to $076_h$ |
| Indicate active interface | CiA 302-6 | $07F_h$ |
| Sync | CiA 301 | $080_h$ |
| Emergency | CiA 301 | $081_h$ to $0FF_h$ ($080_h$ + node-ID) |
| Time stamp | CiA 301 | $100_h$ |
| Safety-relevant data objects | CiA 301 | $101_h$ to $180_h$ |
| TPDO 1 | CiA 301 | $181_h$ to $1FF_h$ ($180_h$ + node-ID) |
| RPDO 1 | CiA 301 | $201_h$ to $27F_h$ ($200_h$ + node-ID) |
| TPDO 2 | CiA 301 | $281_h$ to $2FF_h$($280_h$ + node-ID) |
| RPDO 2 | CiA 301 | $301_h$ to $37F_h$ ($300_h$ + node-ID) |

| Object | Specification | CAN-ID |
|---|---|---|
| TPDO 3 | CiA 301 | $381_h$ to $3FF_h$($380_h$ + node-ID) |
| RPDO 3 | CiA 301 | $401_h$ to $47F_h$ ($400_h$ + node-ID) |
| TPDO 4 | CiA 301 | $481_h$ to $4FF_h$ ($480_h$ + node-ID) |
| RPDO 4 | CiA 301 | $501_h$ to $57F_h$ ($500_h$ + node-ID) |
| Default SDO server-to-client | CiA 301 | $581_h$ to $5FF_h$ ($580_h$ + node-ID) |
| Default SDO client-to-server | CiA 301 | $601_h$ to $67F_h$ ($600_h$ + node-ID) |
| Dynamic SDO request | CiA 302-5 | $6E0_h$ |
| Node claiming procedure | CiA 416-1 | $6E1_h$ to $6E3_h$ |
| Node claiming procedure | CiA 416-1 | $6F0_h$ to $6FF_h$ |
| NMT error control | CiA 301 | $701_h$ to $77F_h$ ($700_h$ + node-ID) |
| Layer setting services | CiA 305 | $7E4_h$ to $7E5_h$ |



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